

Full Nearshore Data 2013 - 2017 (CPUE)

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All Nearshore Data with Effort

So I want to calculate CPUE for each site and year and species (Although I'm Mainly interested in largemouth bass Species code = 317). I went through the data sheets for 2013 and entered weights so I will also want to use this data file for the Wr analysis.

CPUE by Species and Year

Load Bio and Effort Data

```
bio1 <- read.csv("Data/Raw-Data/Nearshore-Biodat_2013-2017.csv")

eff1 <- read.csv("Data/Raw-Data/Effort-Nearshore_2013-2017.csv") %>%
  arrange(Year,Site) %>%
  filterD(!is.na(STARTTIME))
```

Data Preparation

Create Effort Variable (Hours Electrofishing)

```
### create Effort variable (Seconds)
eff1$effort.s <- eff1$ENDTIME-eff1$STARTTIME
eff1$effort.min <- (eff1$effort.s)/60
eff1$effort.hr <- (eff1$effort.min)/60

### Using efishing Hours
eff <- eff1 %>% group_by(Year,Site) %>%
  summarize(effort = sum(effort.hr))

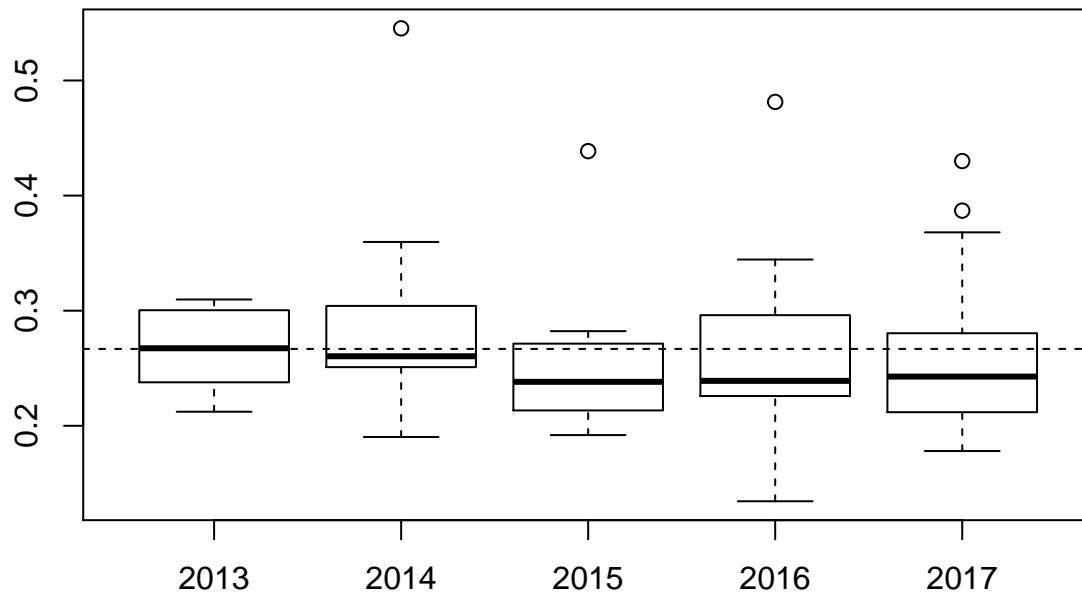
str(eff)

## Classes 'grouped_df', 'tbl_df', 'tbl' and 'data.frame': 62 obs. of 3 variables:
## $ Year : int 2013 2013 2013 2013 2013 2013 2013 2013 2013 2014 2014 ...
## $ Site : int 2 4 6 8 10 15 18 19 1 2 ...
## $ effort: num 0.254 0.293 0.212 0.232 0.243 ...
## - attr(*, "vars")= chr "Year"
## - attr(*, "drop")= logi TRUE

headtail(eff)

##   Year Site   effort
## 1  2013    2 0.2536111
## 2  2013    4 0.2930556
## 3  2013    6 0.2122222
## 60 2017   18 0.3680556
## 61 2017   19 0.2072222
## 62 2017   20 0.1944444
```

Mean Effort Hours E-fishing



```
##   Year mean.effort      sd
## 1 2013   0.2666319 0.03646603
## 2 2014   0.2875694 0.09357196
## 3 2015   0.2567500 0.07021804
## 4 2016   0.2625463 0.08912971
## 5 2017   0.2619444 0.07164949
```

Note:

There is no effort data for Sites 11 and 12 during 2013.

```
## [1] "2013 Sites"
## [1]  2  4  6  8 10 15 18 19
## [1] "Sites 11 & 12 are Missing"
```

I will need to throw out fish from sites 11 and 12 during 2013.

```
##   Site FID Weight Length Sex
## 55  11   4   160   224   2
## 56  11   3   273   266   2
## 57  11   7   316   273   2
## 58  11   6   350   318   2
## 59  11   2   604   348   2
## 60  11   1   968   395   1
## 61  11   8  1159   426   1
```

```
## [1] "No largemouth bass from site 12"
## [1] "Number of largemouth bass in site 11"
## [1] 7
```

This will remove 7 largemouth bass from site 11 in 2013.

Sum Fish of each Species Caught by Year and Site

```
bio <- bio1 %>% group_by(Year, Site, Species) %>% summarize(caught = sum(Count)) %>%  
  as.data.frame()
```

```
headtail(bio, n=2)
```

```
##      Year Site Species caught  
## 1  2013    2    302        1  
## 2  2013    2    313        1  
## 160 2017   18    331        8  
## 161 2017   20    334        3
```

```
headtail(eff, n=2)
```

```
##      Year Site  effort  
## 1  2013    2 0.2536111  
## 2  2013    4 0.2930556  
## 61 2017   19 0.2072222  
## 62 2017   20 0.1944444
```

Note:

It looks like I have effort data for site 19 from 2016 and 2013 but no fish. It must be that only non sport fish were caught at site 19 so there is no length data. Add Zeros later in document.

2013

```
## [1]  2  4  6  8 10 15 18  
## [1]  2  4  6  8 10 15 18 19
```

2014

```
## [1]  1  2  4  6  8 10 11 12 15 16 18 19  
## [1]  1  2  4  6  8 10 11 12 15 16 18 19
```

2015

```
## [1]  2  4  5  6  8 11 12 15 18 19  
## [1]  2  4  5  6  8 11 12 15 18 19
```

2016

```
## [1]  2  4  6  8 10 11 12 13 14 15 18  
## [1]  2  4  6  8 10 11 12 13 14 15 18 19
```

2017

```
## [1]  1  3  4  6  8  9 10 11 12 15 16 17 18 20  
## [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20
```

Join Bio and Effort Data

```
catch <- left_join(eff, bio, by = c("Year", "Site")) %>% as.data.frame()
```

```
headtail(catch)
```

```
##      Year Site    effort Species caught
## 1   2013    2 0.2536111    302      1
## 2   2013    2 0.2536111    313      1
## 3   2013    2 0.2536111    314     25
## 167 2017   18 0.3680556    331      8
## 168 2017   19 0.2072222     NA     NA
## 169 2017   20 0.1944444    334      3
```

```
str(catch) # Needs to be data frame
```

```
## 'data.frame':    169 obs. of  5 variables:
## $ Year   : int   2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
## $ Site   : int    2 2 2 2 2 2 4 4 4 4 ...
## $ effort : num   0.254 0.254 0.254 0.254 0.254 ...
## $ Species: int   302 313 314 316 317 702 41 302 313 314 ...
## $ caught : int    1 1 25 1 22 2 1 1 1 7 ...
```

Add Zeroes for Species Not Observed in a Site

```
catch %<>% addZeroCatch("Site", "Species", zerovar = "caught") %>% arrange(Year,
  Site)
```

```
headtail(catch) ### Here are the zeroes for site 19 2013 and 2016 problem resolved
```

```
##      Year Site    effort Species caught
## 1   2013    2 0.2536111    302      1
## 2   2013    2 0.2536111    313      1
## 3   2013    2 0.2536111    314     25
## 891 2017   20 0.1944444    342      0
## 892 2017   20 0.1944444    702      0
## 893 2017   20 0.1944444    705      0
```

Make CPUE Variable (Catch/Houre of Electrofishing)

```
catch %<>% mutate(cpe.hr = caught/effort)
```

```
headtail(catch, n = 2)
```

```
##      Year Site    effort Species caught    cpe.hr
## 1   2013    2 0.2536111    302      1 3.943045
## 2   2013    2 0.2536111    313      1 3.943045
## 892 2017   20 0.1944444    702      0 0.000000
## 893 2017   20 0.1944444    705      0 0.000000
```

```
# 3-1-2018#write.csv(catch, 'Data/Clean-Data/CPUE_2013-2017.csv', row.names =
# FALSE)
```

Summarize CPUE by Year for Each Species

```
cpeSum <- catch %>% group_by(Year, Species) %>% summarize(samples = n(), fish = sum(caught),
  mean = mean(cpe.hr), sd = sd(cpe.hr), se = sd/sqrt(samples), RSE = se/mean *
  100) %>% as.data.frame()

cpeSum[cpeSum$Species == 317 | cpeSum$Species == 314 | cpeSum$Species == 316,
]
```

##	Year	Species	samples	fish	mean	sd	se	RSE
## 6	2013	314	7	127	71.8572699	75.2102960	28.4268199	39.56012
## 8	2013	316	5	6	4.3459212	7.7050991	3.4458251	79.28871
## 9	2013	317	8	107	48.5050901	38.1860135	13.5007946	27.83377
## 23	2014	314	10	105	34.5481707	38.5759345	12.1987816	35.30949
## 25	2014	316	9	17	4.7220131	6.8529679	2.2843226	48.37603
## 26	2014	317	12	143	42.0562258	32.0103960	9.2406054	21.97203
## 40	2015	314	8	58	30.4822974	55.9306843	19.7744831	64.87202
## 42	2015	316	9	14	5.8836209	8.7498728	2.9166243	49.57193
## 43	2015	317	10	80	32.4573882	34.7940909	11.0028576	33.89939
## 57	2016	314	9	85	36.1232367	79.1416555	26.3805518	73.02931
## 59	2016	316	9	5	1.6992025	3.0689286	1.0229762	60.20331
## 60	2016	317	12	144	44.6088125	56.3436827	16.2650202	36.46145
## 74	2017	314	12	43	11.2466746	14.8906857	4.2985707	38.22082
## 76	2017	316	15	2	0.3361708	0.8902308	0.2298566	68.37494
## 77	2017	317	14	43	10.4363107	17.4461257	4.6626732	44.67741

```
# 3-1-2018#write.csv(cpeSum, 'Data/Clean-Data/summary-data/cpeSum.csv', row.names
# = FALSE)
```

CPUE by Gabelhouse Length Category

- 1) First, I will make new data object (bio2) and add species names (Sp.Names, character variable). This way I can conveniently sort each species of fish into its correct Gabelhouse length category based on its length using psdAdd from the FSA package.
- 2) Second, I'll remove species that do not have Gabelhouse length categories (Hybrids & non-sport fish) as well as sites 11 and 12 from 2013 as before.
- 3) I will add zeroes for all species and gcat (of each species) for every site and year. Check that I made the data correctly and make an output .csv

1) Sort all Species of Fish into their correct Gabelhouse length categories.

Make New Biodat object with Gabelhouse Length Categories Assigned to Species

```
headtail(bio1)
```

```
##          PROJCODE Species Year Site FID Weight Length AC Age SexCon Sex
## 1    NS2013.02.1     302 2013   2  NA     NA    168  2  NA      6   2
## 2    NS2013.02.1     313 2013   2  99     NA    152  3   1      1   1
## 3    NS2013.02.3     314 2013   2  NA     NA     74  3  NA     NA  NA
## 1223   NS2017.20     334 2017  20  NA    500    346  3  NA     NA  NA
## 1224   NS2017.20     334 2017  20  NA    495    364  3  NA     NA  NA
## 1225   NS2017.20     334 2017  20  NA    435    399  3  NA     NA  NA
##          Count
## 1             1
## 2             1
## 3             1
## 1223          1
## 1224          1
## 1225          1
```

```
bio2 <- bio1
```

```
bio2$Sp.Name <- numeric(nrow(bio2))
```

```
headtail(bio2)
```

```
##          PROJCODE Species Year Site FID Weight Length AC Age SexCon Sex
## 1    NS2013.02.1     302 2013   2  NA     NA    168  2  NA      6   2
## 2    NS2013.02.1     313 2013   2  99     NA    152  3   1      1   1
## 3    NS2013.02.3     314 2013   2  NA     NA     74  3  NA     NA  NA
## 1223   NS2017.20     334 2017  20  NA    500    346  3  NA     NA  NA
## 1224   NS2017.20     334 2017  20  NA    495    364  3  NA     NA  NA
## 1225   NS2017.20     334 2017  20  NA    435    399  3  NA     NA  NA
##          Count Sp.Name
## 1             1      0
## 2             1      0
## 3             1      0
## 1223          1      0
## 1224          1      0
## 1225          1      0
```

```

for (i in 1:nrow(bio2)) {
  if (bio2$Species[i] == 41) {
    bio2$Sp.Name[i] = "Longnose Gar"
  } else if (bio2$Species[i] == 171) {
    bio2$Sp.Name[i] = "Shorthead Redhorse"
  } else if (bio2$Species[i] == 201) {
    bio2$Sp.Name[i] = "Spottail Shiner"
  } else if (bio2$Species[i] == 203) {
    bio2$Sp.Name[i] = "Spotfin Shiner"
  } else if (bio2$Species[i] == 301) {
    bio2$Sp.Name[i] = "White Perch"
  } else if (bio2$Species[i] == 302) {
    bio2$Sp.Name[i] = "White Bass"
  } else if (bio2$Species[i] == 311) {
    bio2$Sp.Name[i] = "Rock Bass"
  } else if (bio2$Species[i] == 312) {
    bio2$Sp.Name[i] = "Green Sunfish"
  } else if (bio2$Species[i] == 313) {
    bio2$Sp.Name[i] = "Pumpkinseed"
  } else if (bio2$Species[i] == 314) {
    bio2$Sp.Name[i] = "Bluegill"
  } else if (bio2$Species[i] == 316) {
    bio2$Sp.Name[i] = "Smallmouth Bass"
  } else if (bio2$Species[i] == 317) {
    bio2$Sp.Name[i] = "Largemouth Bass"
  } else if (bio2$Species[i] == 319) {
    bio2$Sp.Name[i] = "Black Crappie"
  } else if (bio2$Species[i] == 324) {
    bio2$Sp.Name[i] = "Orangespotted Sunfish"
  } else if (bio2$Species[i] == 331) {
    bio2$Sp.Name[i] = "Yellow Perch"
  } else if (bio2$Species[i] == 334) {
    bio2$Sp.Name[i] = "Walleye"
  } else if (bio2$Species[i] == 342) {
    bio2$Sp.Name[i] = "Logperch"
  } else if (bio2$Species[i] == 702) {
    bio2$Sp.Name[i] = "Pumpkinseed Bluegill Hybrid"
  } else if (bio2$Species[i] == 705) {
    bio2$Sp.Name[i] = "Green Sunfish Bluegill Hybrid"
  } else {
    bio2$Sp.Name[i] = "Longear Sunfish"
  }
}
}
bio2 %<>% mutate(lcat20 = lencat(Length, w = 20)) %>% mutate(lcat10 = lencat(Length,
  w = 10)) %>% mutate(gcat = psdAdd(Length, Sp.Name))

```

```

## No known Gabelhouse (PSD) lengths for Green Sunfish Bluegill Hybrid
## No known Gabelhouse (PSD) lengths for Logperch
## No known Gabelhouse (PSD) lengths for Longear Sunfish
## No known Gabelhouse (PSD) lengths for Orangespotted Sunfish
## No known Gabelhouse (PSD) lengths for Pumpkinseed Bluegill Hybrid

```



```
## No known Gabelhouse (PSD) lengths for Spotfin Shiner
## No known Gabelhouse (PSD) lengths for Spottail Shiner
gcat.bio <- bio2 %>% group_by(Year, Site, Species, gcat) %>% summarize(caught = sum(Count)) %>%
  as.data.frame()
```

```
headtail(gcat.bio, n = 2)
```

```
##      Year Site Species    gcat caught
## 1   2013    2    302    stock      1
## 2   2013    2    313    quality     1
## 319 2017   20    334    stock      2
## 320 2017   20    334    quality     1
```

```
str(gcat.bio)
```

```
## 'data.frame':    320 obs. of  5 variables:
## $ Year   : int  2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
## $ Site   : int  2 2 2 2 2 2 2 2 2 2 ...
## $ Species: int  302 313 314 314 314 316 317 317 317 702 ...
## $ gcat   : Factor w/ 6 levels "substock","stock",...: 2 3 1 2 3 1 1 2 3 NA ...
## $ caught : int  1 1 1 16 8 1 9 7 6 2 ...
```

Note: No Gabelhouse length category data for Green Sunfish Bluegill Hybrid, Logperch, Orangespotted Sunfish, Pumpkinseed Bluegill Hybrid, Spotfin Shiner, Spottail Shiner. This seems obvious but is good to take note of. Im going to go back and remove those species

2) Remove Unwanted Data

See Source

Merge Effort and Bio Data

```
headtail(eff)
```

```
cpe <- left_join(eff, gcat.bio, by = c("Year", "Site")) %>% as.data.frame()
```

```
headtail(cpe, n = 2)
```

```
##      Year Site  effort Species    gcat caught
## 1   2013    2 0.2536111    302    stock      1
## 2   2013    2 0.2536111    313    quality     1
## 301 2017   20 0.1944444    334    stock      2
## 302 2017   20 0.1944444    334    quality     1
```

```
str(cpe)
```

```
## 'data.frame':    302 obs. of  6 variables:
## $ Year   : int  2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
## $ Site   : int  2 2 2 2 2 2 2 2 2 4 ...
## $ effort : num  0.254 0.254 0.254 0.254 0.254 ...
## $ Species: int  302 313 314 314 314 316 317 317 317 41 ...
## $ gcat   : Factor w/ 6 levels "substock","stock",...: 2 3 1 2 3 1 1 2 3 1 ...
## $ caught : int  1 1 1 16 8 1 9 7 6 1 ...
```

3) Add Zeroes for Each Species and Gabelhouse Length Category

```
cpe %<>% addZeroCatch("Site", "Species", zerovar = "caught") %>% arrange(Year,
  Site) ### add zeroes for species

cpe$ID <- paste(cpe$Year, ".", cpe$Site, ",", cpe$Species) ### create new ID variable

cpe %<>% addZeroCatch("ID", "gcat", zerovar = "caught") %>% arrange(Year, Site)
## add zeroes for all empty gcats for each species at each site for every
## year

cpe %<>% dplyr::select(Year:caught) ### remove the ID variable created above
```

Check if I Need to Remove Any Sites from a Particular Year

2013

```
Remove.Sites$rm.13
```

```
## [1] 1 5 11 12 13 14 16
```

```
tmp.13 <- cpe[cpe$Year == 2013, ]
unique(tmp.13$Site)
```

```
## [1] 2 4 6 8 10 15 18 19
```

2014

```
Remove.Sites$rm.14
```

```
## [1] 5 13 14
```

```
tmp.14 <- cpe[cpe$Year == 2014, ]
unique(tmp.14$Site)
```

```
## [1] 1 2 4 6 8 10 11 12 15 16 18 19
```

2015

```
Remove.Sites$rm.15
```

```
## [1] 1 10 13 14 16
```

```
tmp.15 <- cpe[cpe$Year == 2015, ]
unique(tmp.15$Site)
```

```
## [1] 2 4 5 6 8 11 12 15 18 19
```

2016

```
Remove.Sites$rm.16
```

```
## [1] 1 5 16
```

```
tmp.16 <- cpe[cpe$Year == 2016, ]
unique(tmp.16$Site)
```

```
## [1] 2 4 6 8 10 11 12 13 14 15 18 19
```

```
### I guess im good then
```

Check All Zeroes are Present

```
xtabs(caught ~ Species + gcat + Year, data = cpe)
```

```
## , , Year = 2013
##
##      gcat
## Species substock stock quality preferred memorable trophy
##   302      0      4      0      0      0      0
##   311      0      0      0      0      0      0
##   312      0      0      0      0      0      0
##   313      0     10      5      0      0      0
##   314      5     81     40      1      0      0
##   316      1      3      2      0      0      0
##   317     16     38     39     14      0      0
##   319      0      0      0      0      1      0
##   331      2      1      0      0      0      0
##   334      0      0      0      0      0      0
##   41       1      0      0      0      0      0
##
## , , Year = 2014
##
##      gcat
## Species substock stock quality preferred memorable trophy
##   302      0      1      0      0      0      0
##   311      3      5      5      1      0      0
##   312      0      1      0      0      0      0
##   313      1     16     11      0      0      0
##   314     12     49     43      1      0      0
##   316      4      1      6      6      0      0
##   317      3     65     57     18      0      0
##   319      0      0      1      0      0      0
##   331     14      8      4      0      2      0
##   334      0      0      0      0      1      0
##   41       0      2      0      0      0      0
##
## , , Year = 2015
##
##      gcat
## Species substock stock quality preferred memorable trophy
##   302      0      0      0      0      0      0
##   311      8      2      1      0      0      0
##   312      0      2      0      0      0      0
##   313      2     14      1      0      0      0
##   314      1     30     23      3      0      1
##   316      5      5      3      1      0      0
##   317     13     14     38     15      0      0
##   319      1      0      0      0      0      0
##   331      4      2      1      0      0      0
##   334      2      0      0      0      0      0
##   41       0      0      0      0      0      0
##
## , , Year = 2016
##
```

```
##          gcat
## Species substock stock quality preferred memorable trophy
##    302         0    0        0          0          0    0
##    311         0    0        0          0          0    0
##    312         0    0        0          0          0    0
##    313         0    0        0          0          0    0
##    314         4   73        7          1          0    0
##    316         0    2        1          1          1    0
##    317        34   53       47         10          0    0
##    319         0    0        0          0          0    0
##    331         0    0        0          0          0    0
##    334         0    0        0          0          0    0
##    41          0    0        0          0          0    0
```

```
## , , Year = 2017
```

```
##          gcat
## Species substock stock quality preferred memorable trophy
##    302         0    0        0          0          0    0
##    311         0    1        0          0          0    0
##    312         0    0        0          0          0    0
##    313         2    8        1          0          0    0
##    314         7   23       12          1          0    0
##    316         1    1        0          0          0    0
##    317         7   11       15          9          0    0
##    319         0    0        0          0          0    0
##    331         7    2        2          1          0    0
##    334         3    5        3          0          0    1
##    41          0    0        0          0          0    0
```

```
xtabs(caught ~ Species + Year, data = cpe)
```

```
##          Year
## Species 2013 2014 2015 2016 2017
##    302     4    1    0    0    0
##    311     0   14   11    0    1
##    312     0    1    2    0    0
##    313    15   28   17    0   11
##    314   127  105   58   85   43
##    316     6   17   14    5    2
##    317   107  143   80  144   42
##    319     1    1    1    0    0
##    331     3   28    7    0   12
##    334     0    1    2    0   12
##    41      1    2    0    0    0
```

```
## Year
## 2013 2014 2015 2016 2017
## 264 341 192 234 123
```

```
## Year Sp.Richness
## 1 2013          8
## 2 2014         11
## 3 2015          9
## 4 2016          3
## 5 2017          7
```

Make CPUE Variable

```
cpe %<>% mutate(cpe.hr = caught/effort)
```

Save Data File

Summarize CPUE by Site and Gcat

```
cpeSum.gcat <- cpe %>% group_by(Year, Species, gcat) %>% summarize(samples = n(),
  fish = sum(caught), mean = mean(cpe.hr), sd = sd(cpe.hr), se = sd/sqrt(samples),
  RSE = se/mean * 100) %>% as.data.frame()

# 3-1-2018#write.csv(cpeSum.gcat, 'Data/Clean-Data/summary-data/cpeSum_gcat.csv', row.names
# = FALSE)
```

##	Year	Species	gcat	samples	fish	mean	sd	se	RSE
##	2013	317	stock	8	38	17.527	11.054	3.908	22.298
##	2014	317	stock	12	65	19.249	22.371	6.458	33.550
##	2015	317	stock	10	14	5.650	10.021	3.169	56.081
##	2016	317	stock	12	53	17.014	18.763	5.417	31.836
##	2017	317	stock	14	11	2.879	5.601	1.497	51.986
##	2013	317	quality	8	39	17.259	16.422	5.806	33.640
##	2014	317	quality	12	57	16.880	10.812	3.121	18.490
##	2015	317	quality	10	38	15.024	17.079	5.401	35.947
##	2016	317	quality	12	47	14.510	15.632	4.513	31.101
##	2017	317	quality	14	15	3.469	7.719	2.063	59.464
##	2013	317	preferred	8	14	5.987	10.157	3.591	59.985
##	2014	317	preferred	12	18	4.938	3.671	1.060	21.457
##	2015	317	preferred	10	15	6.202	6.308	1.995	32.168
##	2016	317	preferred	12	10	2.419	8.381	2.419	100.000
##	2017	317	preferred	14	9	2.374	4.074	1.089	45.861

Interesting CPE for quality and Preferred fish may be decreasing.

I think they may have only measures large LMB during 2017?maybe?